

WHAT IS CLAIMED IS:

1. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, a
5 waveguide, a plurality of slots formed on the waveguide and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a dielectric body, and a vacuum chamber, wherein a plasma is generated by an electromagnetic wave radiated from
10 the slots into the vacuum chamber through the electromagnetic wave radiation window, the plasma processing apparatus being constructed such that:

the plasma processing apparatus includes a plurality of the waveguides, which are arranged in
15 contact with each other;

the plasma processing apparatus includes an electromagnetic wave distributing waveguide portion for distributing the electromagnetic wave from the electromagnetic wave source into the plural waveguides;
20 and

the electromagnetic wave radiation window constitutes a part of the wall of the vacuum chamber, and the vacuum condition is retained between the electromagnetic wave radiation window and the other
25 wall of the vacuum chamber.

2. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave

source for generating an electromagnetic wave, an
electromagnetic wave distributing waveguide portion for
transmitting the electromagnetic wave generated from
the electromagnetic wave source, a waveguide connected
5 to the electromagnetic wave distributing waveguide
portion, a plurality of slots formed on the waveguide
and constituting a waveguide antenna, an electro-
magnetic wave radiation window consisting of a
dielectric body and arranged to face the plural slots,
10 and a vacuum chamber including the electromagnetic wave
radiation window as an incident surface of the
electromagnetic wave, wherein a plasma is generated by
the electromagnetic wave radiated from the slots into
the vacuum chamber through the electromagnetic wave
15 radiation window, the plasma processing apparatus being
constructed such that:

the plasma processing apparatus includes a
plurality of the waveguides;

the electromagnetic wave distributing waveguide
20 portion serves to distribute the electromagnetic wave
generated from the electromagnetic wave source into
each of the plural waveguides; and

each of the plural waveguides is branched from the
electric field plane or the plane perpendicular to the
25 magnetic field plane of the electromagnetic wave
distributing waveguide portion.

3. A plasma processing apparatus for performing a

plasma processing, comprising an electromagnetic wave
source for generating an electromagnetic wave, an
electromagnetic wave distributing waveguide portion for
transmitting the electromagnetic wave generated from
5 the electromagnetic wave source, a waveguide connected
to the electromagnetic wave distributing waveguide
portion, a plurality of slots formed on the waveguide
and constituting a waveguide antenna, an electro-
magnetic wave radiation window consisting of a
10 dielectric body and arranged to face the plural slots,
and a vacuum chamber arranged to include the
electromagnetic wave radiation window as an incident
plane of the electromagnetic wave, wherein a plasma is
generated by the electromagnetic wave radiated from the
15 slots into the vacuum chamber through the electro-
magnetic wave radiation window, the plasma processing
apparatus being constructed such that:

the plasma processing apparatus includes a
plurality of the waveguides;

20 the electromagnetic wave distributing waveguide
portion serves to distribute the electromagnetic wave
generated from the electromagnetic wave source into
each of the plural waveguides; and

the transmission direction of the electromagnetic
25 wave is bent at substantially right angles in the
electromagnetic wave distributing waveguide portion so
as to permit the electromagnetic wave to be distributed

into the plural waveguides.

4. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an
5 electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide portion, a plurality of slots formed on the waveguide
10 and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of an dielectric body and arranged to face the plural slots, and a vacuum chamber arranged to include the electromagnetic wave radiation window as an incident
15 surface of the electromagnetic wave, wherein the plasma processing apparatus is constructed such that:

a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window;

20 the plasma processing apparatus includes a plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave generated from the electromagnetic wave source into
25 each of the plural waveguides;

each of the plural waveguides is branched from the electric field plane of the electromagnetic wave

distributing waveguide portion; and

the electromagnetic wave distributing waveguide portion and the plural waveguides are arranged on substantially the same plane.

5 5. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from
10 the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide portion, a plurality of slots formed on the waveguide and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a
15 dielectric body and arranged to face the plural slots, and a vacuum chamber arranged to include the electromagnetic wave radiation window as an incident surface of the electromagnetic wave, wherein the plasma processing apparatus is constructed such that:

20 a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window so as to carry out the plasma processing;

 the plasma processing apparatus includes a
25 plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave

generated from the electromagnetic wave source into each of the waveguides; and

the shortest distance between the inner surfaces of the adjacent waveguides is not larger than the width between the inner surfaces of the one waveguide.

6. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide portion, a plurality of slots formed on the waveguide and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a dielectric body and arranged to face the plural slots, and a vacuum chamber arranged to include the electromagnetic wave radiation window as an incident surface of the electromagnetic wave, wherein the plasma processing apparatus is constructed such that:

a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window;

the plasma processing apparatus includes a plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave

generated from the electromagnetic wave source into each of the plural waveguides; and

the plural waveguides are branched from the electromagnetic wave distributing waveguide portion
5 toward both side.

7. The plasma processing apparatus according to claim 6, wherein the plural waveguides are branched at substantially right angles from the electromagnetic wave distributing waveguide portion toward both sides.

10 8. The plasma processing apparatus according to claim 6, wherein the electromagnetic wave distributing waveguide portion and the plural waveguides are arranged on substantially the same plane.

15 9. The plasma processing apparatus according to claim 2, wherein a plurality of electromagnetic wave radiation windows are arranged such that the vacuum condition is maintained between the plural electromagnetic wave radiation windows and the vacuum chamber.

20 10. The plasma processing apparatus according to claim 3, wherein a plurality of electromagnetic wave radiation windows are arranged such that the vacuum condition is maintained between the plural electromagnetic wave radiation windows and the vacuum
25 chamber.

11. The plasma processing apparatus according to claim 4, wherein a plurality of electromagnetic wave

radiation windows are arranged such that the vacuum condition is maintained between the plural electromagnetic wave radiation windows and the vacuum chamber.

5 12. A plasma processing apparatus, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from the electromagnetic
10 wave source, a waveguide connected to the electromagnetic wave distributing waveguide portion, a plurality of slots formed in the waveguide and constituting a waveguide antenna, and a vacuum chamber maintaining the vacuum condition, wherein the plasma
15 processing apparatus is constructed such that:

 a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber;

 at least one waveguide is arranged in the vacuum chamber; and

20 a dielectric body member constituting a part of the wall surface of the vacuum chamber is formed in the said waveguide, the vacuum condition is maintained by a part of the wall of the waveguide, the dielectric body member, and another part of the vacuum chamber, and the
25 electromagnetic wave is introduced into the vacuum chamber through the dielectric body member.

 13. The plasma processing apparatus according to

claim 12, wherein the dielectric body member fills substantially the entire volume within the waveguide.

14. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide portion, a plurality of slots formed on the waveguide and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a dielectric body and arranged to face the plural slots, and a vacuum chamber including the electromagnetic wave radiation window as an incident surface of the electromagnetic wave, wherein a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window, the plasma processing apparatus being constructed such that:

the plasma processing apparatus includes a plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave generated from the electromagnetic wave source into each of the plural waveguides; and

wherein the slots are distributed substantially

uniformly over the entire area that is to be subjected to the plasma processing.

15. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave
5 source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide
10 portion, a plurality of slots formed on the waveguide and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a dielectric body and arranged to face the plural slots, and a vacuum chamber including the electromagnetic wave
15 radiation window as an incident surface of the electromagnetic wave, wherein a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window, the plasma processing apparatus being
20 constructed such that:

the plasma processing apparatus includes a plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave
25 generated from the electromagnetic wave source into each of the plural waveguides; and

wherein a plurality of the electromagnetic wave

radiation windows are hermetically arranged in a manner to correspond commonly to the plural slots, and the vacuum condition is maintained between the plural electromagnetic wave radiation windows and the vacuum chamber.

16. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide portion, a plurality of slots formed on the waveguide and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a dielectric body and arranged to face the plural slots, and a vacuum chamber including the electromagnetic wave radiation window as an incident surface of the electromagnetic wave, wherein a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window, the plasma processing apparatus being constructed such that:

the plasma processing apparatus includes a plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave

generated from the electromagnetic wave source into each of the plural waveguides; and

the electromagnetic wave radiation window substantially equal in width to the waveguide is
5 arranged in a manner to correspond to each of the waveguides;

the major axis direction of the waveguide substantially coincides with that of the electromagnetic wave radiation window;

10 the length in the major axis direction of the waveguide substantially coincides with that of the electromagnetic wave radiation window; and

the period of the major axis of the waveguide substantially coincides with the that of the
15 electromagnetic wave radiation window.

17. The plasma processing apparatus according to claim 16, wherein the length in the major axis direction of the electromagnetic wave radiation window is shorter than that of the waveguide.

20 18. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from
25 the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide portion, a plurality of slots formed on the waveguide

and constituting a waveguide antenna, an electro-
magnetic wave radiation window consisting of a
dielectric body and arranged to face the plural slots,
and a vacuum chamber including the electromagnetic wave
5 radiation window as an incident surface of the
electromagnetic wave, wherein a plasma is generated by
the electromagnetic wave radiated from the slots into
the vacuum chamber through the electromagnetic wave
radiation window, the plasma processing apparatus being
10 constructed such that:

the plasma processing apparatus includes a
plurality of the waveguides;

the electromagnetic wave distributing waveguide
portion serves to distribute the electromagnetic wave
15 generated from the electromagnetic wave source into
each of the plural waveguides; and

wherein the dielectric body member commonly in
contact with at least one electromagnetic wave
radiation window is arranged within the vacuum chamber.

20 19. A plasma processing apparatus for performing a
plasma processing, comprising an electromagnetic wave
source for generating an electromagnetic wave, an
electromagnetic wave distributing waveguide portion for
transmitting the electromagnetic wave generated from
25 the electromagnetic wave source, a waveguide connected
to the electromagnetic wave distributing waveguide
portion, a plurality of slots formed on the waveguide

and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a dielectric body and arranged to face the plural slots, and a vacuum chamber including the electromagnetic wave radiation window as an incident surface of the electromagnetic wave, wherein a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window, the plasma processing apparatus being constructed such that:

the plasma processing apparatus includes a plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave generated from the electromagnetic wave source into each of the plural waveguides; and

wherein the beam body supporting each of the electromagnetic wave radiation windows on the side of the vacuum chamber is covered with the dielectric body member at least.

20. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for transmitting the electromagnetic wave generated from the electromagnetic wave source, a waveguide connected to the electromagnetic wave distributing waveguide

portion, a plurality of slots formed on the waveguide and constituting a waveguide antenna, an electromagnetic wave radiation window consisting of a dielectric body and arranged to face the plural slots, and a vacuum chamber including the electromagnetic wave radiation window as an incident surface of the electromagnetic wave, wherein a plasma is generated by the electromagnetic wave radiated from the slots into the vacuum chamber through the electromagnetic wave radiation window, the plasma processing apparatus being constructed such that:

the plasma processing apparatus includes a plurality of the waveguides;

the electromagnetic wave distributing waveguide portion serves to distribute the electromagnetic wave generated from the electromagnetic wave source into each of the plural waveguides; and

wherein a water cooling pipe for controlling the temperature is arranged within the beam body positioned between the adjacent electromagnetic wave radiation windows for supporting the electromagnetic wave radiation windows or in that portion of the beam body which is in contact with the waveguide.

21. A plasma processing apparatus for performing a plasma processing, comprising an electromagnetic wave source for generating an electromagnetic wave, an electromagnetic wave distributing waveguide portion for

transmitting the electromagnetic wave generated from
the electromagnetic wave source, a waveguide connected
to the electromagnetic wave distributing waveguide
portion, a plurality of slots formed on the waveguide
5 and constituting a waveguide antenna, an electro-
magnetic wave radiation window consisting of a
dielectric body and arranged to face the plural slots,
and a vacuum chamber including the electromagnetic wave
radiation window as an incident surface of the
10 electromagnetic wave, wherein a plasma is generated by
the electromagnetic wave radiated from the slots into
the vacuum chamber through the electromagnetic wave
radiation window, the plasma processing apparatus being
constructed such that:

15 the plasma processing apparatus includes a
plurality of the waveguides;

the electromagnetic wave distributing waveguide
portion serves to distribute the electromagnetic wave
generated from the electromagnetic wave source into
20 each of the plural waveguides; and

wherein a gas introducing pipe is formed within
the vacuum chamber below the beam body positioned
between the adjacent electromagnetic wave radiation
windows for supporting the electromagnetic wave
25 radiation windows or below that portion of the vacuum
chamber which is in contact with the waveguide.

22. A plasma processing apparatus for performing a

plasma processing, comprising an electromagnetic wave
source for generating an electromagnetic wave, an
electromagnetic wave distributing waveguide portion for
transmitting the electromagnetic wave generated from
5 the electromagnetic wave source, a waveguide connected
to the electromagnetic wave distributing waveguide
portion, a plurality of slots formed on the waveguide
and constituting a waveguide antenna, an electro-
magnetic wave radiation window consisting of a
10 dielectric body and arranged to face the plural slots,
and a vacuum chamber including the electromagnetic wave
radiation window as an incident surface of the
electromagnetic wave, wherein a plasma is generated by
the electromagnetic wave radiated from the slots into
15 the vacuum chamber through the electromagnetic wave
radiation window, the plasma processing apparatus being
constructed such that:

the plasma processing apparatus includes a
plurality of the waveguides;

20 the electromagnetic wave distributing waveguide
portion serves to distribute the electromagnetic wave
generated from the electromagnetic wave source into
each of the plural waveguides; and

wherein a gas introducing pipe is formed of a
25 dielectric body within the vacuum chamber under the
electromagnetic wave radiation windows or integrated
the electromagnetic wave radiation windows.

23. The plasma processing apparatus according to claim 6, wherein the slot is formed in the electromagnetic wave distributing waveguide portion, too.